DRAFT
GROUNDWATER INFORMATION SHEET

1,2,3-Trichloropropane (TCP)

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The purpose of this groundwater information sheet is to provide general information regarding a specific constituent of concern (COC). The following information is pulled from a variety of sources and data relates mainly to drinking water. For additional information, the reader is encouraged to consult the references cited at the end of the information sheet.

GENERAL INFORMATION	
Constituent of Concern	1,2,3-Trichloropropane (TCP)
Aliases	Allyl trichloride, glycerol trychlorohydrin, trichlorohydrin
Chemical Formula	$C_3H_5Cl_3$
CAS No.	96-18-4
Storet No.	77443
Summary	The California Department of Health Services (DHS) identifies 1,2,3 Trichloropropane as an unregulated chemical (no Maximum Contamaniant Level) requiring monitoring. The DHS advisory action level is 0.005 µg/L. Common anthropogenic sources of TCP include discharges related to solvent use. Based on DHS data through 2001, 28 of approximately 16,000 public drinking water wells (active and standby status) have had concentrations of TCP ≥ 0.005 µg/L, with most detections occurring in Los Angeles, Fresno and Kern Counties.

REGULATORY AND WATER QUALITY LEVELS[1]		
Type	**Agency**	**Concentration**
Federal MCL	US EPA, Region 9	N/A
State MCL	DHS	N/A
Action Level	DHS	0.005 µg/L
Detection Limit for Purposes of Reporting (DLR)	DHS	0.005 µg/L
Others: Preliminary Remediation Goal (PRG) –Tap Water ($1/10^6$ cancer risk) Preliminary Remediation Goal (PRG) –Tap Water (long term exposure) IRIS Reference Dose (non-cancer health effects)	US EPA, Region 9	0.0016 µg/L 0.030 µg/L 42.0 µg/L

[1]These levels generally relate to drinking water, other water quality levels may exist. For further information, see A Compilation of Water Quality Goals (Marshack, 2000).

SUMMARY OF DETECTIONS IN PUBLIC DRINKING WATER WELLS[2]	
Detection Type	**Number of Groundwater Sources**
Number of active and standby public drinking water wells[3] with TCP concentration ≥ 0.005 µg/L.	28 of approximately 16,000
Top 3 counties having public drinking water wells[3] with TCP concentration ≥ 0.005 µg/L.	Los Angeles, Fresno, Kern

[2]Based on DHS data collected from 1984-2000 (Geotracker).
[3]In general, drinking water from active and standby wells is treated or blended so consumers are not exposed to water exceeding MCLs. Individual wells and wells for small water systems not regulated by DHS are not included in these figures.

ANALYTICAL INFORMATION		
Method	**Detection Limit (Quantitation Limit)**	**Note**
US EPA 504.1, 551.1	0.02 – 0.08 µg/L (0.1 µg/L)	DHS approved for public drinking water systems
US EPA 524.2	0.03 µg/L (0.5 µg/L)	DHS approved for public drinking water systems
US EPA 8260B	0.09 – 0.32 µg/L (1 – 5 µg/L)	Site Assessment
LLE-GC/MS and PT-GC/MS	0.005 µg/L	Developed by DHS

Known Limitations to Analytical Methods	US EPA methods 8010, 8021, or 8260, approved for TCP analysis have quantitation limits of 10, 5 and 1 to 5 µg/L, respectively. However, note that these are above the DLR. Two methods; LLE-GC/MS (Liquid-Liquid Extraction and Gas Chromatography) and PT-GC/MS (Purge and Trap Gas Chromatography), are able to measure TCP at the DLR. They were recently developed by DHS, but are expensive and require well experienced analysts.
Public Drinking Water Testing Requirements	TCP is an unregulated organic chemical in public water systems requiring monitoring and reporting by DHS. A DHS Action Level of 0.005 µg/L was established in 1999. Analytical methods to meet the action level were established in 2002. Data are being collected to enable DHS to ascertain the extent of TCP in California groundwater and subsequently to decide whether an MCL for TCP is appropriate.

TCP OCCURRENCE	
Anthropogenic Sources	In the past, TCP has been used mainly as a solvent and an extracting agent (paint and varnish remover, cleaning and degreasing agent, and cleaning and maintenance solvent). Currently, TCP is used as a chemical intermediate in the production of polysulfone liquid polymers and dichloropropene, synthesis of hexafluoropropylene, and as a crosslinking agent in the synthesis of polysulfides. TCP has been formulated with dichloropropenes in the manufacturing of a soil fumigant nematocide D-D, which is no longer available in the United States.
Natural Sources	TCP is a manufactured chemical and does not occur naturally in the environment.
History of Occurrence	TCP was found in extracts of treated groundwater associated with hazardous waste cleanup at a southern California Superfund site in the late 1990's. This prompted DHS to establish a 0.005-µg/L action level in 1999. Since then, TCP has been found in 28 groundwater samples at concentrations ranging from 0.02 to 68 µg/L. The highest concentrations of TCP were measured in Los Angeles County and were related to the hazardous waste sources. Excluding LA County, values ranged from 0.02 to 1.06 µg/L. TCP was found in groundwater at 0.71% of the sites in the Contract Laboratory Program Statistical Database (includes data from both National Priority List [NPL or Federal Superfund] and non-NPL sites), at a geometric mean

	concentration of 57.3 µg/L (CLPSD, 1989). TCP was found in 39% of 941 U.S. groundwater samples recorded in EPA's STORET database at a median concentration of 0.69 µg/L, at an average concentration of 1.0 µg/L, and a range from trace (below unspecified detection limit) to 2.5 µg/L (EPA STORET, 1989, cited by Agency for Toxic Substances and Disease Registry, 1992). In 1974, TCP was also qualitatively detected in effluent from an advanced waste treatment plant in Lake Tahoe.
Contaminant Transport Characteristics	TCP is slightly soluble in water, with a reported solubility range from 1,900 mg/L to 2,700 mg/L. Reportedly, TCP has a very low soil sorption coefficient. The U.S. EPA published a K_{oc} value of 51. TCP is not readily degraded in most groundwaters, and would be readily transported within an aquifer following the hydraulic gradient. Because it's density (1.4) is heavier than water, pure-phase liquid TCP will sink into deeper parts of an aquifer in the form of a dense non-aqueous phase liquid (DNAPL).

REMEDIATION & TREATMENT TECHNOLOGIES	
Groundwater Remediation	There was no specific information found on remediation of groundwater contaminated by TCP. However, it is expected that TCP can be removed using methods applied for other chlorinated hydrocarbons, such as pump and treat, in-situ oxidation, permeable reactive barriers, dechlorination by hydrogen releasing compound, and emerging biodegradation techniques. <u>Natural Attenuation</u> There were no data found on natural attenuation of TCP, but it may occur under favorable conditions. The half-life of TCP, based on acclimated aerobic soil grab samples, was from 6 months to 1 year (1 to 2 years in groundwater). However, these values may differ from those in groundwater. At most contaminated sites, solvents last much longer than would be expected if this half-life was an accurate estimate of in-situ behavior.
Drinking Water and Wastewater Treatment	Above ground treatment, as for other chlorinated hydrocarbons, may consist of an air stripping and an activated carbon filtration technique. UV radiation can also be used for a low-flow system. Wastewater treatment plants use chemical oxidizers like potassium permanganate, and increasingly

	biodegradation processes to remove chlorinated hydrocarbons from water. The above mentioned treatment methods are relatively costly and may be economically inefficient to remove TCP action levels. Testing water at parts per trillion (ppt) level is also difficult.

HEALTH EFFECT INFORMATION

Acute Health effects: Contact with TCP can irritate and burn the skin and eyes. Breathing TCP can irritate the nose, throat and lungs, cause headache, affect concentration, memory and muscle coordination.

Chronic Health Effects: there are no data on chronic health effects associated with TCP.

Cancer Hazard: TCP has been shown to cause cancer in animals, and is known to the State of California to cause cancer, for purposes of the Safe Drinking Water and Toxic Enforcement Act of 1986 ("Proposition 65"). TCP was added to the list of carcinogens in 1992. The DHS action level for drinking water is based on potential cancer risk.

KEY REFERENCES

1. Agency for Toxic Substance Control and Disease Registry (ATSDR), *ToxFAQs for 1,2,3-Trichloropropane*. http://www.atsdr.cdc.gov/tfacts.html (Sept. 2002)

2. Book S., California Department of Health Services, Personal Communication, April 2002.

3. California Department of Health Services. *Drinking Water Standards: Unregulated Chemicals Requiring Monitoring*. http://dhs.ca.gov/ps/ddwem/chemicals/unregulated/index.htm (Sept. 2002)

4. California Department of Health Services. Determination of 1,2,3-Trichloropropane in Drinking Water by Continuous Liquid-Liquid Extraction and Gas Chromatography/Mass Spectrometry. Berkeley, California. February 2002.

5. California Environmental Protection Agency / Regional Water Quality Control Board, Central Valley Region. August 2000. *A Compilation of Water Quality Goals*. Prepared by Jon B. Marschack. http://www.swrcb.ca.gov/rwqcb5/available_documents/wq_goals/wq_goals.pdf

6. Howard, P. H. Handbook of Environmental Degradation Rates. CRC Press LLC. 1991.

7. Montgomery, J.H. Groundwater Chemicals Desk Reference. 3rd Edition, Lewis Publishers, 2000

8. U.S. Environmental Protection Agency. Drinking Water Standards and Health Advisories. EPA 822-B-00-001. Summer 2000.

9. U.S. Environmental Protection Agency, Region 9. Preliminary Remediation Goals http://www.epa.gov/region09/waste/sfund/prg/index.htm (Sept. 2002)

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